The Information Revolution and The Future Role of Educators

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International Handbook on Information Systems. H. Adelsberger, Collis, B., & Pawlowski, J. (Eds.). Berlin: Springer-Verlag.

Last updated 10 April 2000

Introduction

The purpose of this chapter is to examine past, current and emerging trends in information and communications technology (ICT), look into the future and identify trends and implications for the professional educator regarding the use of instructional technology (IT) for education and learning. Throughout this chapter, I use the term educator to refer to all professionals who are engaged in the processing of helping people learn, including public, private and government sectors.

Predicting the future is too heady stuff for this author. Does it mean extrapolation? "Predicting the future usually means extrapolating today's fashions into long-term trends." (Allen, 2000, p. 14) Or does it mean backlash? "In naming the future, it seems fitting to proceed with a little help from Hegel. Historical epochs do tend to react against the excesses of their predecessors, though that is never all they do." (Reilly, 2000, p. 31). Perhaps all we can say with some certainty is that "Life is full of surprises." (Vladimir Nabokov in Allen, 2000). Alan Kay, evidently a bolder fellow, and one-time Apple Fellow, stated that the best way to predict the future is to invent it.

Predicting the rate at which the future will unfold is equally chancy. One view is the rate of change will accelerate as more and more people become connected, aware of other accomplishments, and are able to contribute to growth at a distance. More will be said about this 'global brain' concept later in this chapter.

It is evident from viewing our surroundings and reading, that major change, even epoch change is occuring. Mitchell (1999, p. 20) observed "The last 100 years has brought a transformation of the world of the university unparalleled since the great era of change in

the time of the Sophists and Plato. A knowledge revolution centered around dramatic technological advances has vastly accelerated change, especially in the last 30 years."

In an article on the future of the university, Noam (1996, p.38) presenteed a gloomy picture of the future of education when he observed that "many of the physical mega universities of the present are not sustainable, certainly not in their present duplicative variations" and that "ten years from now a significant share of conventional mass education will be offered commercially and electronically."

It is obvious to all who purchase communications technology that stunning change is evident in 'machine' technology; defined as the hardware and visible components of ICT. The prominence of machine technology overshadows the equally or more important 'intellectual' technology; the skill to develop programs, algorithms, mathematics and linguistics that drive the machine technology (Bell, 1999). Advances in intellectual technology of the digitial computer have equalled or exceeded those of machine technology.

Kanter (2000, p. 34).argues "The advent of the Internet is a massive, even unprecedented exercise in managing change…Success requires changing the model for how to organise the work and lead the organisation. It requires challenging traditional assumptions about organisation, communication, decision-making, operating style, managerial behaviour -- and then defining a new way. *That is a human problem, not a technological one*." (emphasis added).

What happens to the role of the professional educator when the ICT revolution poses the means to change both the way we conduct our classroom instruction and to shake the

foundation of the culture of the institutions of education to their very core? Is it a case of survival or "this too shall pass" or major shifts in the way we think of and structure education?

This chapter is an attempt to extract some broad ideas from history and apply them to the future. It is not a detailed technical treatise nor is it an accurate history of IT. Others have written extensively on those topics.

Overview

The Post-Industrial Society

Daniel Bell introduced the term Post-Industrial Society in the updated version of his 1973 classic (Bell, 1999). Since then, the term has been used in an astonishing range of subjects such as how to transition to this ICT society in an era of aging populations; inner city dislocations; and was even linked to the unabomber, whose published manuscripts on the topic led to his identification and subsequent arrest.

Compared with the previous society, Bell characterized the PIS is characterized by several major trends.

- The growth of the service sector and decline of manufacturing (the latter from 26% of the jobs 25 years ago to 15% at the present).
- The rise of the professional and technical worker and decline of the skilled and semi-skilled.
- Education supplants inheritance as a means to obtaining a place in society.
- Changing view of capital from simply land and money to include human capital.

- Broadening of the term technology to include machines to intellectual capital (programming, linguistics, algorithms).
- Expansion of infrastructure development from transportation to communication.
- From labor theory of value to knowledge theory of value.

Cattell (in Bell, 1999) extended emphasis from PIS to "informationalism", defined as the current revolution in [the application of] the technologies of information, processing and communication. This current revolution is built upon electronics (which replace machinery), miniaturization (which gives greater information processing power per unit size), digitization (which replaces information in analog or wave form) and software (which replaces swapping equipment by rapid and effective change and upgrades to meet new conditions).

Evolution of Digital Machine and Intellectual Technology

Part of the answer to "Where are we headed?" lies in the answer to "Where have we been?" Machine technology (hardware) may be defined as the physical components of computers--monitors, mice, CPUs and so forth. Intellectual technology consists of the program, algorithms and applications which give life to the machine technology. The evolution or development of both forms of technology over the years has had a major impact on IT and gives us a basis for limited forecasting into what the future might bring which will allow a certain amount of speculation as to the future and IT. Gains in the areas of central processing units, input/output devices, telecommunications and software have kept pace with one another to support increased power and development in each of these separate areas.

Central processing units

Central processing units began life as massive devices which filled whole rooms and required vast amounts of air conditioning to remove the heat from vacuum tubes. They became experimentally available in the 1940s and commercially available in the 1950s. The invention of the transistor and later the microchip gave birth to Moore's law and the size of cpus decreased and their power increased, both exponentially. Stages in the transition included minicomputers, such as the IBM 1130 and the VAX 11780, to be followed by micromputers, the ultimate individual machine. The trend toward smaller stand alone devices reversed, in order to allow the sharing of resources into local area then wide area networks. The present state of evolution is an extensive array of millions of powerful microcomputers (servers), configured to share resources across a vast network of interconnected desktop microcomputers, also known as (clients), all communicating using the same platform-independent language, HTML, and its successors. The Internet, preliminary and not (yet) worldwide and afflicted with growing pains is rapidly approaching infancy.

Input/output interface devices

In the interface between the technology and user, there has been stunning change. Early on, punched cards and printed tapes were the input devices and rolls of paper the output, printed by modified electric typewriters. Gradually these were replaced by so-called dumb terminals which displayed input and out on a graphics screen. The early terminals themselves had no memory could only display capitalized text in monochromatic format. With the advent of the microcomputer and the integration of some memory from the main cpu to the terminal, terminals began to be equipped with memory and could perform functions under the direction of the main computer. Soon to follow were graphic display units which employed color, a variety of standard fonts, and programmable character sets

which could be used for simple animation. The next major evolutionary step was for computer terminals and microcomputers to display any and all multimedia forms of information. This gave rise to several terms, namely GUI for graphical user interface, and WYSIWYG for What you see is what you get. We are now witnessing what is called convergence, the integration of all forms of media in digital format and presented through the computer screen.

Telecommunications

Early mainframe computers could only run a single job at a time, therefore the communication was intensely personal (dedicated). Timesharing capitalized on the tremendous processing speed of mainframes and allows many runs to be completed in such rapid sequence they appeared to be dedicated to single users while in fact there are many simultaneous users at various locations around the world. Communication progressed from dedicated copper wires to telephone, microwave and satellite linkages and enabled users to access specific computers from anywhere in the world using commercially available systems. In the transition from mainframes to micros, local area network communication systems were devised to connect (network) several micros together. During the cold war, redundant telecommunication paths were created to foil destruction of vital communications links in the event of a real war. These systems laid the foundation for today's communications protocols in which millions of servers and clients can communicate with each others' machines, with immense volumes of electronic traffic managed by powerful data switches. This is the basis for the Internet. All the while, the communications systems were able to accommodate ever larger files with greater speed. This is associated with the common term called bandwith. At the time of this writing, we are witnessing the ability to send large files over great distances, e.g., complete hour long full color, full motion video, at great speeds.

Locating people has always been problematic. Should we phone (work, home, golf course), fax, pager, build a fire or send e-mail? Currently, systems are being developed and tested which provide a single number for each individual. This number will track the person down and send the message in the most appropriate format. This may eventuate as one unique Internet Protocol (IP) number per person.

Telecommunication networks have vastly changed the nature of the functionality of computers. Once only a tool to carry out numerical analysis, the digital computer is now a major vehicle for facilitation of communication among resources and people to the extent that a special term, Computer-Mediated Communication (CMC) has developed to describe this phenomenon. "Once video transmission becomes commonplace, computer networks will in fact synthesize the capabilities of the other media. They can provide face-to-face interaction through video conferencing and all the text, videos, and software that the world produces. Mastery of this medium then will involve mastery of all the other media (Collins, Neville, & Bielaczyc, 1999). Invariable, reports of using telecommunications for distance education are enthusiastic except when systems are used outside the context of meeting specific needs (Mason, 1999). For more on CMC, see Berge & Collins (1995, 1998).

However, communicating with the world through the Internet is like viewing it through binoculars: while some things are magnified and clarified, many key elements of the environment which provide rich cues to meaning are shut out. Weiser & Brown (1998) describe some current and future state of the art digital technologies which are being developed to reduce this bias.

Software

Software is the intellectual technology behind the machine technology and it too has undergone massive transformations, of which only a few will be mentioned here. Programs to control the functions of mainframes were written in obscure, unhumanlike protocol, such as assembler language, which took years to master. Over the years, systems for creating software grew in 1) closer proximity to human language, 2) specialization and 3) power. For example, Fortran was designed to process mathematical formulae, COBOL to process lists of information, and LISP to process propositional inferences such as if-then statements. One outcome was to increase programmers' productivity by leaps and bounds.

In the late 1950's, the potential for computers to provide instruction (information transmission, infinite patience, limited answer judging, branching, one-to-one tutors etc.) began to be applied in a field known as computer assisted instruction (CAI). This was an offshoot of the earlier teaching machine and programmed instruction movements (Feldhusen & Szabo, 1969). Soon specialized programming languages, such as Pilot and Coursewriter, adapted from business applications to implement instructional activities began to appear. Other languages, such as Tutor, were developed explicitly for the creation (authoring) of instructional materials (courseware) to be delivered by computer. Because of their specialized nature, these languages gave further impetus to the development of CAI systems. Avner (1981) was one of the earliest to document extensive gains in courseware development productivity attributable to such newly emerging features as interactive editing, graphics representation, rapid prototyping and team development, among others. But they still required the skills and dedicated time of experienced programmers, and most educators were not willing to develop the necessary expertise, nor were educational institutions willing to become involved.

The next stage was the appearance of complete systems to create, or 'author' CAI lessons with programs which used instructional logic but did not require programming skills. Authoring systems, as they were called, such as Authorware brought the reality that CAI could be created by educators unwilling to become programmers. The history of software applications has been to render them at the same time easier to use and more powerful in terms of results.

A major problem with CAI and other software programs and products was distribution. Many programs developed on one brand of computer could not be operated on another brand. Programs had to be physically sent to and installed on other identical computers in order to distribute them. This began to change when physicists recognized the need to share their research with colleagues around the world without having to wait for machine translations and distribution. They developed a language protocol which would display text on a wide range of computers and used the Internet to distribute specially 'marked-up' documents. These documents could instantly link to other documents on servers around the world with special but inexpensive software, today called browsers.

Eventually this 'mark-up' language, referred to as HTML, was expanded to include large files capable of displaying graphics, audio, animation and video over the Internet networks, which were steadily moving toward higher bandwith. Today this is known as the World Wide Web or for those with slow modems, the World Wide Wait.

A concomitant development was the ability of programs to reduce computer files to a fraction of their original size. Compression allows for faster transmission of ever larger and larger computer files, which process the receiving machine would reverse

(decompress the file back to its original size) with little loss of fidelity. The process of compression and decompression has been subdivided to the point where small chunks of large files are compressed, shipped and while the first chunk is decompressing, the second chunk is compressing and being sent. The effect is the illusion of continuous motion (not unlike individual frames which make up analogue motion pictures) or continuous audio. This is referred to streaming and is common among radio stations today.

What of the future of machine and intellectual technology?

Assuming Moore's law is not repealed, we can make four predictions about the ICT and therefore IT infrastructures of the future. First, bandwidth will continue to increase and render the incorporation of today's state of the art multimedia into powerful, immersive learning experiences. Issues in the use of WWW as an immersive learning environment are discussed by Ruzic (1999). Next, wires will disappear as people slip into their pockets (or strap on) wireless communication devices that will enable them to access every resource in the world, including education services and those resources which they individually have contributed. Third, behind the scenes will reside massive relational databases which can be easily queried in natural, spoken language to obtain whatever information is required (and legal and ethical, of course). Finally, the sum of all changes now happening and predicted to occur in the future will lead to a new organizational structure for the provision of education services around the world. These four infrastructures will be expanded later in this chapter.

The Changing Student Population

Now there is evidence students are changing in ways that have serious implications for the future of education. A comprehensive series of surveys of American colleges and

universities reveals the old idea of a collegial community of scholars, students and faculty is disappearing. Levine & Cureton (1998) reveal how todays' students are different.

- More racially diverse
- Considerably older
- Nontraditional (eg 39% are working full time)
- Want a different relationship with college, like consumer expectations of a bank, telephone company, or supermarket
    - Nearby for easy access
    - Operate at more convenient hours (24 hours?)
    - No lines
    - Polite friendly and helpful staff
    - High quality education
    - Low costs
- Make much larger demands on Faculty
- Are target audiences for alternatives to traditional education, such as stripped down versions of college which keep costs down by heavy teaching loads, limited selection of majors, and few electives
- Less interested in campus governance
- Move overwhelmed and damaged (growth of psychological and support services)
- Reduced collegial social life
- Less well prepared academically
- With rooms equipped with VCRs, computers, and WWW, choose to live lives whereby they can avoid venturing out if they so choose
- More binge drinking
- Pursuit of academic goals purely utilitarian, with out which a lucrative or prestigious job is impossible

- Perform best in direct, concrete, linear, experience-based and moderately structured learning, while faculty prefer global concepts, ideas and abstractions and assume students need high levels of autonomy
- Take longer to graduate (fewer that 40% are able to graduate in four years)

"In sum, these changes in America's undergraduates add up to a requiem for historic notions of collegiate life -- the ivory tower, the living-learning community, the residential college, and all the rest." (Levine & Cureton 1998, p. 51).

The Corporate Learning Model

Why the corporation?

"The multinational corporation is the dominant social institution of our time. Its only potential rival, the state, is busily transferring whole areas of responsibility into its hands, through privatization of social services, deregulation of markets and binding trade agreements like the North American Free Trade Agreement and the General Agreement on Tarriffs and trades." (Evener, 2000, C8). The emerging economy demands a new set of policies which most left-of-center European leaders have embraced (Reich, 2000). Called the third way, the core ideas are 1) rejection of state ownership of the economy, 2) inevitability of global trade and investment, 3) requirement of labor market flexibility, 4) trimming of social safety nets, and 5) slashing of budget deficits. The explicit assumption is that the have nations will assist the have-not nations to achieve parity.

Drucker (Evener, 2000) saw that unlike the state, church or army, corporations must constantly transform themselves to maintain stability. This activity makes it the ideal candidate to provide leadership in the rapidly changing modern society. This

responsibility falls directly on corporate managers. While Drucker admired corporate managers he studied, he was concerned they are not accountable to anyone for the vast power they wield, and they may be enjoying the rewards of leadership but rejecting the mantle of social leadership.

And what of education 'managers'? Drucker (Upbin, 1999) says the U.S. education system is over administered and under managed (there are a lot of bureaucrats but they don't produce the output they are hired to produce).

Some trends in corporate learning

Many corporate training institutions currently exist, such as McDonald University, Motorola University and IBM University. These are but a few of several trends involved in corporate learning. Another trend is that educational institutions can partner with corporations to provide current training, often in technology areas. An example is a joint project between the University of Technology, Sydney and AMP, a large Australian insurance company. In Sweden, Universities are required to meet obligations to serve labor-market needs (Government of Sweden, 1999). Questions such as what are a corporate universities?, How do they work? and What are some of the principles they follow? are discussed by Meister (1998). The story of a public community college's program to establish meaningful relationships with the surrounding business community (Rao, 1999) is just one example of many such efforts. In another response to this trend, The Innovations in Corporate Education Forums were held to offer proven applications for effectively building corporate and university partnerships through the vehicle of a conference in San Diego in 1999. (REF?)

Other trends involve corporations providing resources and support for education. For example, IBM's reinvention project, Microsoft In Education, AT&T's Learning Network.

Special universities have been created to meet the needs of older adults, with emphasis upon the corporate environment. A partial list of examples would include the University of Phoenix, the Open Universities of the UK and USA, Athabasca University, and Indira Ghandi University. The University of Phoenix with 60,000 students and 1997 profits of $33M, DeVry, Inc. (Ruch, 1999) with 48,000 students and $24M in profits, and ITT, Education Management and Strayer Eduction, Inc., with 26,000, 19,000 and 10,000 students respectively (Winston, 1999). Continuing professional education is becoming increasingly competetive. Student devotion to specific institutions is waning with the availability of alternative sources for upgrading, be they around the corner or elsewhere on the globe. Nor are they hung up by "artificial status considerations" (Guiton, 1999, p. 50).

For-profit institutions are considered by Winston (1999, p. 13) who observed

> The vision--or specter--is simple. *New information technologies* (emphasis added) and the organizational efficiencies of privatization can lower the cost of producing higher education enough that for-profit schools can compete with existing nonprofit and public colleges and universities by offering students a better deal and still making a profit. Or they'll produce an education that students deem more appropriate, improving quality from the consumer's point of view. So, costs and prices will be lower, or the education will be different and better, or both.

After a detailed analysis of some key issues, Winston concludes that 1) for-profit competition will chiefly impact colleges and universities with meager donative resources and modest student subsidies, and 2) others schools will be forced to clarify "what it is they sell, educationally, and whom they will allow to produce it" (p. 18).

How do we balance the "reality of competition which is undercutting the university" with the belief that entering the global market cheapens and will ultimately undermine the whole notion of a university" (Mason, 1998, p. 151).

Selling educational products (except texts) to the education market used to be for fun and profit, with emphasis on the fun. Now the profit picture is looming larger. Consider Advantage Learning Systems, which sells instructional aids and computerized quizzes to monitor their results. The company has registered 61% annual growth since inception in 1986 (Upbin, 1999).

One area of emphasis is corporate emphasis is software which improves quality control and reduces teachers' clerical work for more important things in the classroom. As an example of the latter, consider Broward County (FL) School's searchable database.

> Last year a Broward math teacher could not understand why his brightest eight-grade students were scoring merely average on their Stanford standardized tests. Before the district put in a searchable database, he would have had to navigate scores of screens to see how each student scored in each subcategory. Instead he simply set up a few queries to generate an instant report. It turned out his students were flunking graph-plotting. He is correcting the problem (Upbin, 1999, p. 72).

It is also interesting to note that the previous two items were not reported in an education journal, rather they were reported in *Forbes*, a magazine aimed at the business community.

The Global Learning Infrastructure

A theme consistent with the global brain is a concept called the global learning infrastructure or GLI. Twigg & Miloff (1998) expand on this concept extensively. They report that societies are facing common themes, such as aging societies and students, workforces needed frequent technology-based training, control and reduction of costs, pressure from demands for new delivery systems and increasing numbers of college and university students. The theme of their solution is "a student-centric virtual global web of educational services--as the foundation for achieving society's learning goals." (1998, 187). Guiton claims that "The increasing availability of on-line resources makes it more plausible, and perhaps more likely, that professionals will seek to direct their own upgrading and change of directions (1999, p. 50).

Other factors which demand attention are declining funds, changing student demographics, growing demands for recurrent lifelong education, diverse prior experience and levels of skill and knowledge, varying learning styles and willingness to look outside the local community for training (Moran & Myringer, 1999).

One element of the GLI is unbundling of services. Currently each institution bundles a wide range of functions, including setting standards, accreditation, registration, payment, content creation, instructional delivery, administration of instructional services and research. With a digital learning infrastructure, these functions can be disaggregated and

redistributed to separate specialized global entities. Thus a student has before him or her an electronic catalogue of courses or internships or coop experiences from every corner of the globe. Partnerships can be formed among conventional institutions and even be extended to include media, publishers, content specialists, and providers of mechanical and intellectual technology.

A key task will be to integrate the instructional programs of various institutions with available and emerging technologies into a coherent learning environment. Developing such a system requires a change of administrative focus from one of being a steward and protector of what has been inherited to innovators who assess roles, identify niche competencies, and form partnerships.

Additional requirements to move to a GLI include the expansion of the Internet to the world. Given that the Internet has other useful features, educational applications may be able to ride a wave of popularity. And as governments move to deregulation of telecoms, service will be enhanced and the Internet will expand. Developing countries may be able to catch up quickly or at least make rapid progress with the development of wireless communications which do not require crushingly heavy investments in cable. Broadband telecommunications are necessary for multimedia, interactive and immersive learning experiences, and real time or synchronous learning.

Courses should be modularized such that the content can be rebundled and repurposed for different audiences and needs. This strategy was followed by the mainframe PLATO system which used a variable management strategy to assemble modules for different occupational streams (Szabo, 1994).

Also needed are open standards to support interoperability in the delivery of marketing, administrative and educational support processes. Twigg and Miloff (p 189) list some examples:

- Preview capabilities for interested users prior to purchase
- Registration and payment
- User tracking and feedback
- Reporting for instructors, students, and educational administrators to monitor individual (own) and group progress and compare to historical or normative standards
- Credit granting
- Applications for financial aid
- Student counseling on courses and career

Internationalism

From a practical point of view, what are some practical barriers to a GLI? (Truehaft, 1999) reported on several of these in describing a multinational training project in Asia. The training was to meet common needs of professionals from the APEC group. One problem was that different countries have different and clashing cultures. Imagine China (One Nation-Two Systems) and Taiwan (Two Nations-Two Systems) in the late 20th Century and you can get the picture. This problem was circumvented by focussing not on culture but on the mutually important theme of economic development. Next there were differences in technology standards and emphases. The closed architecture of virtual learning contrasts sharply with the open architecture model of the WWW. While the project emphasized collaborative efforts for the good of all, there were clear pressures against collaboration. Indeed one Asian representative cautioned against the very word collaboration, as it recalled individuals who collaborated with Japanese invaders during WWII.

The APEC group spans 13 time zones, rendering synchronous instruction all but impossible. The technology was dictated by what everyone had--thus reducing it to the lowest common denominator. Language was a problem, even when English was chosen due to various levels of knowledge. This was partially alleviated by the use of the shortened subset of English known and Airline English because it is spoken by pilots in communication with air traffic controllers around the world. A final problem was disparities between east and west culture. In the former, the teacher is revered, honored and respected. In the latter, it is a free-for-all of give and take, challenge and answer. Couple this with the prediction that western culture will not be the dominant culture of the 21st century and beyond. It will be number four behind Confucian, Hindic, and Islamic cultures. (???, 1998). DATOR?

Discussions of the concept of a global learning environment immediately raise many concers or red flags (notwithstanding the APEC example above). It is instructive to next consider the concept of the global brain as part of these discussions.

The Global Brain, or Two Heads are Better than One!

"Web to weave and corn to grind, Things are in the saddle and ride mankind." Ralph Waldo Emerson (in Wright, 1999). Available at http://www.pathfinder.com/time/magazine/articles/0,3266,36537,00.html

The concept of a global brain has intrigued scholars from many disciplines for years. It goes something like this. The human brain consists of billions of neurons, connected in a massive network or web. By analogy, the world consists of billions of people, connected by technological networks which have evolved over the years. For tens of thousands of years, so the theory goes, technology has been drawing this web of 'human neurons'

together, toward the convergence we are now witnessing in science, technology, politics, art, religion, and all areas of human social endeavor. The beginning may have been in the primordial ooze. This cultural evolution has been gathering momentum, aided by various technological events and shows no sign of abatement.

Here is a current example. The software operating system known as Linux, after its developer, is open and free. Anyone in the world can obtain it and make any changes they wish. The proviso is that the change is shared with the world. The result is that hundreds of programmers are voluntarily giving their time to improve the product to the benefit of the world community. A recent search using the Yahoo search engine under the term Linux revealed over 1000 listings.

When there were only a few million 'brains' in the world, cultural evolution was slow. It took hundreds of thousands of years to get from the hand ax to the ax with handle because there was no network, postal service or other means by which others could examine something and say "Hey, wouldn't it be nice if this had a framistan"? For example, early explorers to isolated Tasmania discovered the inhabitants lacked what the some of the rest of the world had—fire, bone needles, and boomerangs (Wright, 1999). Travel was limited and the network was ill formed.

Then came the technology of writing, followed by printing and the social network and global brain was further strengthened. A major breakthrough occurred when communication was freed from geographical and time restrictions (previously limited by roads, rivers, etc. and could take flight anywhere through phone, fax, e-mail and the Internet). One 'neuron' could now read about something that took place elsewhere in the world and improve upon it. Musicians could put notes on pages, based on the work of the

monk Guido. World knowledge grew and spread. Technology allowed many people in different lands, who would never meet, to collaborate, producing international synergy. Each advance raises the chance for further advances.

Theoretically, every desktop in the world can be linked with every other desktop, although by the time that happens, they probably won't be desktops anymore. Today, the Internet has the potential to unite virtually all the ‘neurons’ on the planet, completing the global brain network structure, perhaps what theologian Pierre Teilhard de Chardin discerned as a “thinking envelope of the earth.” (in Wright, 1999). We are moving from "media by the few for the many" to "media by the many for the many" (Tyner, 1994).

This global brain has potential for good (e.g., sharing the latest medical knowledge about pain or illness) or evil (Neo-Nazi hate propaganda). As Wright (1999) notes, we are free to use it as we want, “enmeshed in a web that would give us the option to exercise either amity or enmity over unprecedented distance with unprecedented power. There are worse fates than to have choices like that." (p. 153).

What are some implications? First, this theory argues for the continued progress of cultural evolution and the global brain. Second, while great progress has been made, it has taken millions of years and is far from complete. The vast majority of the world is not on the Internet at this time and there are large access disparities among various groups on the globe. Third, as noted above and is clear to everyone with Internet experience, the growth can be beneficial or harmful to society as a whole. Fourth, although there are many attempts by educators at globalization through telecommunication projects, the results are not clear, the summaries are discourse rather

than research, and many questions have yet to be asked, let alone answered. (Fabos & Young, 1999). What does this mean to the professional educator?

Reform and Instructional Technology: Reality or Rhetoric?

The rhetoric is that IT is transforming education the way ICT is transforming society. The reality can be seen in many educational institutions where the predominant mode of instruction is CHAI (Chalkboard-Assisted Instruction). There are two issues involved in defining transformation. The first is the use of IT in the classroom, where only a handful of the expected percentage of early adopters (Rogers, 1995) are involved. The second is a bigger issue and tied in with Kanter's assertions above, namely that IT has not fulfilled the promise (some have claimed for it) to reform the way we think about and deliver education. IT has been described by some as having the potential to allow educators to make major strides forward in learning. The lack of reform in education stands in stark contrast to the change swirling about in society because of ICT.

There are many symptoms of this lack of reform: ingrained conservatism, academic insecurities about the nature and tenure of positions (although history shows technology creates more jobs that it destroys), distaste for standardized learning packages, fear of technology, differences among students in taking responsibility for their own learning, fears that universities will see distance education as a cheap solution to large scale delivery (Moran & Myringer, 1999).

Numerous authors and planners have identified smaller pieces of the puzzle and tried to stimulate the use of IT in the classroom through training or support. The most common approaches have been to provide training in how to use IT in education and to obtain IT hardware and software for educators. The results have been highly predictable--brief

success followed by gradual return to the old ways of doing things. Perhaps Mark Twain said it best when he reportedly stated that the only people who like change are those with wet pants.

Academics have developed models and theories of change and related them to the diffusion of innovation. See for example Rogers (1995) and Fullan (1991, 1992). Others have applied larger theories of diffusion of innovation to events in education.

Distilled from this are several principles for diffusion of the innovation called IT.

- It must be guided by a strong vision of the future. This often takes the form several key and respected individuals who are unswervingly dedicated to the cause, sometimes at great personal risk. The institutional 'vision' for change (through IT) must come from the chief academic officers in the form of both undeniable verbal and visible (resource) evidence of commitment. The vision and commitment must be shared at all levels of the institution.
- There must be an atmosphere of experimentation, tolerance of (calculated) risk-taking and viewing of 'failure' as the elimination of a bad idea. People responsible for the operationalization of the vision must 1) be rewarded and 2) not punished (for not doing research, for taking on overloads, etc.. Robert Mager once observed that things which are surrounded by unpleasantness are not surrounded by people.
- Large numbers of people need to be involved in creating and implementing the diffusion process. They must operate at senior, middle level and junior positions, throughout the organization. Because of the massive numbers of educators to be trained and supported, we cannot rely on the methods we have used in the past.
- Patience is needed. Innovation diffusion does not follow the neat package of 5 year terms which characterize administrators and politicians (who must make their mark

on the world in a fixed time frame). Elsewhere in this chapter I provide an estimate of the range of how long it will take to diffuse the IT innovation.

- A wide range of training is needed in IT, how to apply it to a wide range of learning activities, and for leaders, how to provide leadership where resistance to change is a major factor (i.e., wherever people are involved).
- Although IT is not rocket science, the individual method of operation (lone ranger) of most educators requires the availabilty of just-in-time, credible and effective support.

Future of Education in an IT World

The scenario approach

Predicting the future beyond lunch is at once frustrating and unrealistic. An alternative is to consider different plausible scenarios of what might happen, develop a plan for each scenario and monitor events to decide which plan to implement. This scenario strategy has been used extensively in various business-futures planning.

The first scenario is that nothing will change significantly from the current state of affairs. The appropriate strategy might be to maintain a low profile in the trenches, keep your helmet pressed down around your ears and keep your head low. It is regularly practiced by many who are either within five years of retirement or view their role as stewards of the institution who will turn it over to their successors in the same fine shape they received it.

Some have suggested the lack of wisdom of this approach. "Universities won't survive…higher education is in deep crisis. Already we are beginning to deliver more lectures and classes off-campus via satellite or two-way video at a fraction of the cost [of

traditional courses]. Today's [campus] buildings are hopelessly unsuited and totally unneeded." (Peter Drucker, quoted in Green, 1999, p 15).

"In our capitalistic society, which rewards innovation and enterprise, technologies continue to be invented at a prolific rate. But because ours is a democratic capitalism, there usually must be a political or market consensus before we, the people, adopt a fundamentally new way of doing things." (Race, 2000).

In a series of studies of campus computing in the USA, Green paints a somewhat dismal picture of the preparedness for this change when he says "the evidence suggests that as an "enterprise," higher education remains mostly unprepared for the consequences of this coming convergence." (1999, p. 11).

The other extreme end of the scenario spectrum is that the ICT revolution will dramatically effect how instruction is delivered in a major and revolutionary fashion. A teacher from the 1900s who was magically transported to a current classroom would feel quite at home. John Goodlad (in Dator, 1993) surveyed a wide sampling of American schools in every part of the US, and he came to one overwhelming conclusion. In spite of periodic public outcry about the sorry condition of American education, and countless commissions over the years which issued countless calls for curriculum change and innovation--and in spite the attempt by countless teachers to offer innovative courses--the classroom of the present, what is taught in the classroom, and how it is taught, has not changed significantly for over one hundred years.

A teacher of today, transported into this new future, would be bewildered, out of place, and find difficulty determining what to do or say. The viability of this scenario of the

future of education is based on machine and intellectual technologies which have been promised and are being tested at this time, plus successful experiences on smaller or non-educational scales than proposed in the following scenario. Other factors are that in general the world economy is presently in good shape, with resources which were previously aimed at protecting ourselves from one another becoming available to help one another. Another supporting factor is a general recognition that the world's educational systems are not yet perfect, although most proponents of this idea usually 1) have a vested interest in a particular solution and 2) the 'problems' are rarely identified with any degree of precision and thus won't yield to solutions, except by chance. The scenario to be presented rests upon a certain infrastructure becoming available in usable formats. Some of this infrastructure is technological and some is human. There is every reason to expect that 20% of the problems which lie in the path of achieving this future will be technological and the remaining 80% will be of the human kind. Finally, if my assessment of the time scale presented elsewhere in this chapter possesses any validity, the beginnings of that revolution should appear in education during the early decades of the 21st century.

New or Expanded Roles for the Educational Professional

"It is not the strongest species that survive, nor the most intelligent, but the ones most responsive to change." Charles Darwin.

"The significan problems we face cannot be solved at the same level of thinking we were at when we created them." Albert Einstein.

To that end, the author has placed change and reform and innovation at the forefront of expanded roles for educational professionals.

Specialize in Change and Reform

If IT is not "rocket science" and can be implemented by any educator with proper support, particularly that which is provided in the context of the interdisciplinary team (see below), why has it been so little used? One answer whose credibility is growing is that IT represents a major innovation and the diffusion of innovation involves change, that entity which, according to Mark Twain, nobody likes except those with wet pants. Bates (2000) has argued that

> New technologies are associated with posindustrial forms of organization based on highly skilled and flexible workers with a good degree of autonomy organized into relatively small and flexible operational units. In contrast, universities and colleges have been characterized by a mixture of agrarian and industrial forms of organization, with hierarchical, bureaucratic, and relatively inflexible organizational structures and procedures…the introduction of new technologies for teaching will require a major shift toward postindustrial forms of organization for universities and colleges." (pp. 1, 2).

There are many lessons to be learned from the study of development and diffusion of innovation to be applied to the innovation of IT. One key lesson is that diffusion proves more chaotic and unsettling than the ultimate end point-using it to improve and reform education. As fuzzy, hard to define or implement and abstract as the change process is, understanding it is vital to minimizing deleterious effects on the transition process. A key role for the future, has, oddly enough, more to do with developing expertise in innovation diffusion and less with either the machine or intellectual property.

It behooves us to learn all we can about the process of diffusion of innovation (change), whether it comes from a managerial, administrative higher education framework (e.g., Bates, 2000), a business leadership framework (Kotter, 1996; Senge, 1998), a

sociological, psychological framework (Rogers, 1995), or an educational technology framework (Fullan, 1991, 1992, Szabo et al, 1999).

Understand Innovation Rules and How They Apply to IT

The author has approached the lack of diffusion of IT to reform education from a different perspective, one which treats IT as an innovation (Rogers, 1995: Szabo, 1996; Szabo & Anderson, 1997; Szabo, Anderson & Fuchs, 1999). This approach begins with an examination of those factors which characterize successful and unsuccessful innovation, from a variety of fields of human endeavor. It then constructs a system to optimize the effects of those factors. We will briefly look at the characteristics of innovation and how they were incorporated into a system to promote reform of education through IT.

1. Innovation is warmly accepted as an abstract concept but rejected as an operational outcome (the rational behavior of individuals and institutions is to promote stability and resist change). As one vice-chancellor observed "I don't have time for cultural change." (Bates, 2000).
2. The vast majority of innovations fail—they never become widely adopted.
3. Most innovations aren't—they are merely tinkering with the system. "Schools and colleges are as productive and innovative as were Soviet collective farms." (Dator, 1993).
4. Innovations which become successfully diffused often have changed significantly to the point where they are barely recognizable. The telephone arose from an effort to help hearing impaired, etc. This underscores the importance of local control and empowerment to enable people to adapt the innovation to their particular requirements, along with the 'global brain' structure to disseminate the adaptations.

5. Historically diffusion of innovation has taken significantly longer to happen that we remember or hope for. It doesn't fit neatly into the five year appointment cycle of administrators or term of politicians. An example from machine technology is the mouse, which was developed in 1964 but did was not diffused into the computing scene until the introduction of Apple's Macintosh, 20 years later. For more on the man who developed the mouse, look at the Stanford Review of [Doug] Englebart's work at http://unrev.stanford.edu.

   When will diffusion of innovation, particularly of IT, happen? Precision predicting is not possible. However, one view of long range provides some estimates. The estimate is based on the time between the invention or development of some innovative idea and its widespread diffusion. This 'incubation time' has been pegged at roughly 20 years for high tech innovations (e.g., the mouse was introduced in 1964 and set the standard in 1984 with Apple's Macintosh) and educational innovations have larger incubation times. For the sake of argument, I'll choose 50 years for the latter. If we agree that instructional technology is a blend of high tech and educational innovation, we might conclude that the incubation time will be longer than 20 years but less than 50. When do we start marking time? Let's take the beginning of the early computer assisted instruction programs developed for digital computers. That would be around 1960. This yields a likely range of incubation time from 1980 to 2010. This estimate puts us, at the time of this writing, well within the expected period.
6. The innovator is a dedicated keeper of the dream with total focus. The commitment to bring the innovation to life the ability to inspire and motivate others is characteristic of all successful innovations. Due to the vision-driven nature of innovation, since no

one has gone there before, innovation must be guided by a strong, concrete and shared (Senge, 1996) vision.

7. There is a school of thought that innovation can't be managed-it must be led (Kotter, 1996). The main tool in the hands of administrators is policy-formation and it works well in running an institution. However, there is almost no evidence that innovations arise because of administrative policy and it can be argued that administrative policies may be out of step with innovation and inhibit the creativity needed to innovate. As noted futurist Paul Saffo (1997) observed

   > "we are all preoccupied with trying to get standards established, and that's a good thing. But few people realize that once standards are established they stay around for vastly longer than we would wish and are used for purposes we never intended. And that's where vertigo comes in because if people realized the consequence of the standards karma they would be completely immobilized."

8. One view of innovation is that is simply the testing of many good ideas and discarding those which don't work. This means successful innovation is characterized by a great deal of trial and error and discarding failures; however, this activity is easily labeled failure. The majority of institutions and individuals do not tolerate failure and people who are supervised by them tend to be risk-aversive.
9. Innovation as an end has limited value: innovation as a means to an end have tremendous value. The value of IT will come not from itself, per se, but from the extent to which it can help educators 1) do what they normally do to improve learning (e.g., providing quick and detailed performance feedback) and 2) step up to new opportunities and applications previously not addressed (e.g., increasing access to specific learning by specific individuals in specific locations)
10. Related to the previous point, people and institutions pass through three identifiable stages which they encounter an innovation—play, use, create (PUC). The play stage is learning about the innovation—what it can and can't do, how to access and use it,

how to trouble shoot. If learning is successful, the use stage begins in which the innovation is employed to help people accomplish task they already do, such as word processing for handouts, assignments and test items, spreadsheets for accounts and student marks, Only when a certain comfort/competence level is reached does the individual and institution begin to use the innovation to help do those things that couldn't be done, or even imagined earlier. For example the use of IT to provide access to education, training and information in a distributed learning environment (sometimes referred to as any time, anywhere, or just-in-time education). "…teachers, even those most enthusiastic about teaching with technology, typically pass through several distinct stages before they become educational technology integrators and innovators." CEO Forum, 1999, p. 13). Corporate researchers have also identified a similar cycle of technological innovation (Green & Gilbert, 1995). It has happened that an innovation's value was not appreciated because it was in the first stage, for example, the suggestion that a powerful use of the microcomputer would be as a storage and retrieval device for recipes in the kitchen of a home.

11. A critical mass of users is a common hallmark of success of an innovation. Since the IT culture cuts across all subjects, grade levels and barriers of time and geography, every educator is a potential user. One quickly concludes that, using conventional methods, there are not enough trainers or time to provide all the basic training needs, let alone address the on-going requirements of support, upgrades and so forth. It becomes quite clear that to simply provide the necessary training to this large audience requires new initiatives and new solutions.
12. Innovation requires more work than meets the eye or that is described in the project report, and the required resources cannot be predicted in advance with any degree of accuracy. Innovation is an on going process, with no end in sight. Put another way,

every successful innovation, because it changes the system, introduces new problems to be solved. That is a human problem, not a technological one."

Become Versed in Alternative Instructional Strategies

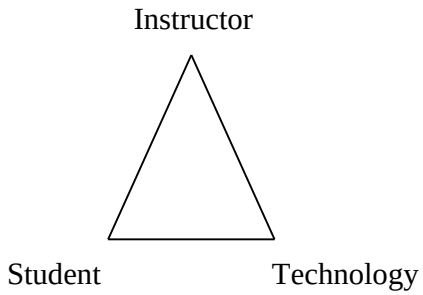
Meeting different client needs calls for tailored instructional strategies. As instructors we can execute a wide range of powerful strategies, but usually only one at a time. For example, learning has been demonstrated to be significantly more efficient when self-pacing is used. IT has demonstrated its ability to promote self-paced learning. For some learners, individual performance feedback of a diagnostic and prescriptive nature can increase learning (Tennyson, 1981, Szabo & Montgomerie, 199x). The immense logistics problems associated with individually assessing, diagnosing, and prescribing individual learning programs across the entire curriculum can be reduced to simplicity through the use of computer-managed instruction.

New instructional strategies become possible and manageable through IT. The predominant and valuable model of learning has been instructivist, which emphasizes the organization, transmission, and memorization of information and is of course needed. Constructivism on the other hand emphasizes "information as something to work with, think with, discuss, negotiate and debate." (Mason, 1998, p. 157). In part this is congruent with the idea that the workers in the post-industrial society will increasingly become information workers. It is argued that IT can promote constructivist learning environments (Jonassen, 199x). Interactive multimedia provides virtual experiences which normally are available only from the experience of the real world environment and then in restricted quantity (Rushkoff, 1994). Perhaps more importantly the student can manipulate reality, observe changes and construct personal knowledge about the world.

A list of early examples would include the Jasper project of Vanderbilt and the principalship simulation (Project Decide) developed at the University of Alberta.

Many argue convincingly that the influence is not in technology but how the technology is used, e.g., Clark (1994) and Scrimshaw (1997). One must frame the use of instructional strategies within a theory of teaching and learning. The predominant current model is that of content; get that right and all else is secondary. This may be called the information transmission model and this mental model held by instructors can be inhibitory to the use of instructional technology (Szabo, 1994).

In contrast, there is the view that learning is also a communicative process among students and between students and instructors (Crook, 1998) which can produce "higher order thinking and reasoning skills." (Mcloughlin, Oliver, & Wood, 1997; Wegerif & Mercer, 1996). The teacher's adds the role of "organizing interaction between learners and as a support, or scaffold for communication." Mcloughlin & Oliver, 1999, p. 36). Teaching evolves to include the three elements of instructor, student and technology as shown below.



Professional development of faculty to prepare them to function in an IT world often takes on one of two approaches. The first is a central support unit which is responsible to the senior administration and provides support services to the whole institution. Another

uses faculty or department-based leadership teams to provide IT leadership to department colleagues. One system which uses a combination of the two was described by Szabo & Anderson (1997).

Focus on the Intellectual Technology, as Well as the Machine Technology

It is often stated that IT is too expensive. Exploring this notion further results in the conclusion that in education, machine technology costs are quantifiable and add-on, while the supposed benefits (increased achievement, effectiveness, attitude and access) are neither 1) easily quantified nor 2) valued in a practical, applied sense in education (which faculty member's increments or other rewards are based on how much their students achieve or how quickly)? In the world of training, on the other hand, the opposite is true and return on investment has generally shown IT to be cost-effective.

While it is true that it is a zero-sum game for machine technology (money spent on IT must come from someone else's budget), the intellectual technology represented in the employees of the university or college is a rich, renewable and expandable resource. And it is this technology which creates the programs which drive the learning process which is presented by the machine technology.

Develop Strategies for New Clients and to Co-Exist with Corporate Training

The basic reactions to new clientele fall into one of three categories: Ignore them, get the institution to deal with them or partner with other agencies to reach them. Partnering with corporations has advantages (resouorces, similar goals, blending of new ideas and strategies, and urgency to get the task underway) but there are also disadvantages. These would include having to establish a working relationship, explaining the limitations of what can be done in light of the corporations' requirements in time and resources, negotiating philosophical differences, and overcoming negative attitudes on both parts. Another barrier is that education as currently practiced falls more into a socialist camp

while businesses are firmly in the capitalist camp. The manifestations are subtle and often undetected until too late because educators do not fully comprehend capitalistic modes of operation and vice versa. And current trends push the issue to the forefront as governments (who often fail to understand capitalism) urge educational institutions to become capitalists, thereby reducing reliance on government spending.

Predict Directions of Computing is Going and The Implications for Education

Networking

The global network of interconnected servers and clients will enable every educator to not only obtain resources from any location in the world, it will also enable ever educator to contribute resources where they have expertise. The ability to contribute, whether as an educator or student, is invigorating and may contribute to the growing global brain concept described earlier.

Broadband Transmission

The first infrastructure technology element is broadband communication which will enable the transmission of interactive and multimedia computer files significantly larger than anything we have today outside the research laboratory. Broadband also enables high quality, such as MPEG2 for digital video/audio and Dolby™ digital for digital audio. These can be supported by high bandwidth satellite, cable and internet for years to come. A read of the .com companys' strategic plans suggests broadband will become an inevitability in the near future.

We have been conditioned to treat multimedia elements of visual instruction as distinct entities, with their own unique features, e.g., text, static visual displays, dynamic visual displays and audio. This conditioning prevents us from considering their value as symbol systems which can be used to enhance learning. Technology enables us to think of integrated multimedia and symbol systems for one simple reason, namely that all forms of multimedia, because of their digital representation, can be combined and delivered through a single entity, the computer screen. The underlying digital nature of all forms of multimedia permit common procedures in the capture, editing, and distribution of multimedia instruction. With the production elements under control, we can focus on the symbol systems associated with media. For example, is the impact of a point of view video different for an individual than for a pair of students working together at a computer? And if there is a difference, is it of high consequence?

Wireless Communication

The second technology infrastructure component, which is currently coming on strong is wireless communication which will permit full access to all educational services we now have and more, from any place in the world without a physical connection. While the Irridium project, which provides telephone access from any location on earth, using 66 satellites recently went bankrupt in 2000, the failure was financial rather than technological. Now image the combination of broadband possibilities with wireless access. Consider the electronic book.

On the day everyone has a single access number and full multimedia capability on a portable wireless device, we will have to rethink how, when and why we communicate with students, colleagues, administrators, suppliers, and experts. We will spend less time dispensing information and more time receiving, adding value and re-directing it to where it can do the most good or where it is needed. This shift in culture will take some getting used to.

Database

The third technology is also currently available as exemplified by the VISA credit card phenomenon which operates with vast interconnected server-driven databases which collect, store, quickly analyze and regurgitate on demand, information requested by authorized users, clients, and administrators in report format which they specify and control. Imagine the existence of master, world wide databases which contain detailed information about every conceivable aspect of educational life everywhere on the globe. These are front-ended with powerful search engines which can be used to identify and abstract the pertinent information in a fraction of a second. A high response time is possible--the PLATO mainframe system guaranteed a 0.8 second response time. Although download delays occuring in the 1990s gave rise to the term "World Wide Wait".

New Models of Operation Infrastructure

The fourth infrastructure component is a function of the human rather than technological concepts. This involves a complete remake of the educational systems of the world. The

earlier quote by Kanter bears repeating here: "The advent of the Internet is a massive, even unprecedented exercise in managing change…Success requires changing the model for how to organise the work and lead the organisation. It requires challenging traditional assumptions about organization, communication, decision-making, operating style, managerial behavior -- and then defining a new way." Indeed it will require a major cultural change (Bates, 2000; Szabo, 1996).

Next, the financial benefits of Moore's law will extend to the world of education. For example, there was much talk in the late 1990s about inexpensive information appliances which would replace powerful microcomputers as interface devices for learning and accessing the Internet. The idea is that the powerful software applications would be stored in server farms and brought to the local client when needed, just-in-time, and discarded when finished. The documents created would be stored in the server farm for easy retrieval. Special languages (e.g., JAVA) were developed to write programs which would enable this to happen. The so called thin client would not require extensive storage capacity, processing power or large files of application programs and would be therefore highly affordable. This concept represents a radical departure from the direction computing has been taking and must be proven not only technologically but more importantly in the market place.

One implication is that information appliances capable of also delivering high bandwidth multimedia lessons via wireless will become widely available and highly affordable. The costs of distance education compared with conventional learning will become exceedingly attractive, especially when one considers the tradeoffs of the time and inconvenieence and lost opportunity costs of relocating to an institution of higher education.

CMC may result in a major leap forward in the development of the global brain, discussed elsewhere in this chapter. It certainly seems to be playing a role in the development of the operating system called Linux. This system is available for free to anyone through computer networks, and is uses standards of open architecture. Anyone can change the code to improve or extend its functionality, but the changes must be made available to other users. Revised theories of learning which place high value on knowledge construction through dialogue with others and reflection may benefit from enhanced CMC in the forms of computer conferencing, e-mail, list servs an other facilities which have yet to be developed.

Is it different this time? Many have painted a rosy picture of the future and dismissed the false starts of the past with "But it's different this time." But is it? The arguments in favor seem to be that it is easy and inexpensive to get connected and to contribute information to the world via the Internet. It is easy to communicate with others around the world albeit in a somewhat constricted and artificial format (Weiser & Brown, 1998). The potential is certainly there for interactivity, which can be highly motivating. It spills over into the world of entertainment which is highly attractive. And vast amounts of information and data and otherwise difficult to obtain resources can be made available at one's fingertips. These factors set the Internet apart from previous history of information and communication technology. They can be used to support the claim that indeed it may be different this time, in spite of the statistics which reveal less than 3% of the world's population use computers and just 33% of those in the richest country in the world, the USA use computers (Tapscott, Lowy, & Ticoll, 1998).

Finally, support for lifelong learning would be facilitated by the inclusion of all educational experiences and requirements of each individual from the time they graduated to retirement. Consider this scenario. All the information used by all educational institutions in the world will be available in a database, or more precisely a series of relational databases replicated at numerous sites. A student could search the database to find out what are the next courses he or she is to complete and where they are offered. A rain forest ecology course is available in Costa Rica and can be taken on site or through the Internet. There is also a coastal environment course in the west of France, a desert ecology course in Morocco, and a cold weather environment course in Aspen, all available on site, via the Internet, or a combination of the two. Instructors could search the database for all courses and modules available in their content area from around the world and incorporate them, with permission, into their own course, or alternatively jointly develop a merged course with the best components from several locations around the world. At the least the educator of the future will need to know how to query the database to retrieve the information desired. Practice with search engines is a good place to start.

Function as a member of an international, interdisciplinary team

Teachers, particularly those in university settings, are hired primarily for their research, publication, and ability to obtain funds. Functioning as part of a team is rarely a major hiring criterion. When it comes to teaching, the predominant mode is that of an individual functioning with a high degree of autonomy with little accountability for the outcomes of the courses. Training in aspects of teaching is rarely provided, let alone training in the use of IT. The design of mediated instruction, however, requires a complex set of skills that few if any possess in its entirety. In contrast, the common mode of developing any significant and non-trivial IT is through teams. While many of

the skill set of traditional IT developers continues to be important, there is an additional set of skills needed, particularly if the concept of the Global Learning Infrastructure is to be developed. Table 1 presents a set of skills and functions of the ideal team of course designers. It should be noted that while few individuals possess all the skills listed in Table 1, the more each member understands of the skills and function of one another, the better the team will function. There is a general shortage of well-qualified, multi-skilled instructional designers with experience in distance and classroom instruction and advanced understanding of technology-based instruction (Moran & Myringer, 1999).

Title	Skill Set	Function
Subject Matter Expert (SME)	A thorough knowledge of the subject matter content and skills to be learned during the course of instruction. An understanding of how people at different levels learn, and knowledge of learning theory as evidenced in instructional strategies	Decide the scope and sequence of the content and skills to be acquired by the target population of students who successfully complete the instruction.
Instructional Designer	Versed in multiple learning strategies and underlying learning theory and rules for selecting those learning strategies. Able to apply principles of systematic design of instruction and multimedia selection skills.	Determine the instructional strategy set which will provide optimal learning of the content and skills. Create design and delivery specifications for course modules.
Media Specialist	Knowledge of digital media design, development and implementation techniques.	Create multimedia elements according to the design document and implement them in the appropriate delivery (file) formats.
Web Master and Programmer	Knowledge of server/client tools and ability to create code in specific languages for instructional and educational management applications.	Move the developed modules to a web server and maintain the server function to meet the design specifications. Develop specialized code for management of learning
Evaluation Specialist	Knowledge of research data and design, collection and analysis to carry out both formative and summative evaluation studies.	Design studies to collect, analyze and interpret data to evaluate all aspects of the products of the design document. Design

		assessment tools used to evaluate learner performance in formative, summative and diagnostic formats.
Curriculum Expert	Knowledge of the complete curriculum which is to be contained in the program of studies, including the offerings available from other agents in the GLI.	Oversee the integration of modules and courses being developed into the total curriculum offering of the GLI
Registrar	Intimate knowledge of the registration requirements of other members of the GLI.	Advise on the details of eligibility, registration, certification, and awarding of credit to learners in the context of the GLI. Interface with inter-institution administration
Marketing Agent	Knowledge of the needs of clients and how to assess them. Ability to market educational programs the institution offers. Liaison with other GLI members in the global consortium. Ability to write proposals and negotiate with publishers and media companies.	Assess the needs of clients and communicate that information to the team. Market educational programs produced by the team and GLI consortium. Secure funding for instructional development and negotiate marketing arrangements with external clients and suppliers.
Project Manager	Ability to clearly communicate and orchestrate the sequence of events needed to produce the course materials. Ability to secure and allocate the resources across the team members. Project planning, budgeting and report writing skills.	Coordinate the entire development process within the team and between clients or sponsors. Document and negotiate changes to the process and control costs.
Target Population Students	1. Knowledgeable students, who have recently completed the learning requirements 2. Naïve students who represent the intended audience for the instruction	1. Contribute ideas to the design and development of the courses and curricula. Complete the course and comment on any portions which are unclear or in error. 2. Complete the course provide feedback on any portions with are unclear or in error.

Table 1. Names, skills sets and functions of team members who build the Global Learning Infrastructure.

Preserve conditions of intellectual freedom and open political institutions

The PIS and its current incarnation, informationalism, promise men and women greater control of their social destinies. "But this is only possible under conditions of intellectual freedom and open political institutions, the freedom to pursue truth against those who wish to restrict it. This is the alpha and omega of the alphabet of knowledge." (Bell, 1999, lxxxiv). But this requires reflective thinking. "In times of rapid technological change, reflective practice is virtually an occupational necessity for everyone (Guiton, 1999, p. 52). What am I doing and why am I doing it? What do I want to change and what do I want to preserve in all this turmoil? As a precaution, be careful of post-modern colonialism or liberalism in which the dominant culture of the provider agencies or nations are 'forced' upon others for the sake of economic or other (implicit) exploitation.

Respond to changes in educational and social goals

Increased demand for intellectual education and training for service, professional and managerial employment, coupled with decreased but nevertheless existing demands for skilled and semi-skilled workers. These latter will be reduced by such technologies as performance support systems and expert systems, which in turn will require building. There will also be a growing need to retrain and re-orient workers displaced by informationalism and provide entry into the market.

Meet needs of changing student population

Treat the student as if he/she were a client who treats education as a commodity, expects good service and can walk to another source if not satisfied. Increase the accessibility and convenience of education. Increase productivity using massive databases. Increase the amount of instruction and instructional management that can be done through instructional technology. Increase individual attention through IT. For example create

and use systems in which students can access automated entry level assessments of prerequisites at the course level. Such a system would assess students, create individual profiles of strengths and weaknesses for each student, suggest action to remediate the weaknesses and automatically make the resources available to the student. Explore new models to serve the client, such as peer tutoring and sharing of information and peer assessment through the use of communication technologies. Levine & Cureton (1998) have concluded that the above describes current US university and college students at the present time.

In learning the student is guided by the technology but at the same time create meaning for him or herself. The result is "freedom to experience knowledge whilst maintaining an individual learner's personal sense of reality." (Ruzic, 1999, p. 188).

Be concerned about issues of ownership of intellectual property rights

"The walls of the academy that previously sheltered the concepts of intellectual freedom are becoming electronic tentacles that extend into the home and the global workplace. The free exchange of ideas and artistic expressions that have traditionally been acceptable inside the classroom may not be so acceptable when other stakeholders in education can view only portions of the educational process. The messages that are part of the give and take of the college classroom processes of synthesis and evaluation may seem different when being delivered over the information highway. The Internet allows educational stakeholders to glimpse classroom 'sound-bites' that may take on entirely different meanings when viewed outside the context of intellectual give and take." "The idea of the virtual classroom and its virtual university makes the distinction between inside and outside the university community more difficult to maintain. Electronic multimedia-on-demand are making the protective walls of the university community very permeable.

The World Wide Web, with its spreading interconnected links to a world-wide array of documents expressing a plethora of ideas, now allows students to both explore those ideas and to freely express their thoughts to a world-wide audience." "Liability and copyright laws are of particular concern. How many times has a student made rash and irresponsible statements in a classroom environment that would lead to potential legal liability were the same statements seen in a public television broadcast?" (Morey, Binning, & Combs, 1996).

Get the facts straight

Recognize that there is mechanical technology and there is also intellectual technology "(based on mathematics and linguistics), which uses algorithms (decision rules), programming (software), models and simulations, in the running of the new "high technology" Bell, 1999, xvii).

Study and recognize what the research says and what it doesn't say about the effectiveness, efficiency, attitude-promotion and access of IT. Differentiate between research and rhetoric and check out the credentials of the researcher. Sources to consider are Jonassen (1996) and Szabo, (1998).

Finally, find out the credentials of anyone who comes along urging a particular course of action, strategy or piece of equipment. It is easy to be swayed by a powerful communicator with ideas which are shallow and self-serving. Take a moment to dig into the speaker's credentials and history. Determine if they are among the world experts in their field and if not, use caution in accepting their recommendations.

Develop and use technology to communicate

Computers aren't just for number-crunching anymore. They have become powerful but limited tools to support a wide range of communications. Explore the limits and limitations of the 'global brain' through supplemental computer mediated communication. Consider the role of reflection and expertise among members of a class and how those elements can be used to enhance and enrich the educational experience of the whole class.

Invent, innovate and diffuse

Create new applications of technology (innovate) to solve educational problems or meet unmet educational needs. One view of innovation is that it is a matter of lots of hard work--testing out as many possibilities as can be envisioned and discarding those that don't work. Get your institution to adopt and adopt these successful new creations (innovate). Use these creations to supplement or replace existing practice, to the extent they are more efficient, reliable or better in other ways (diffuse).

Innovation also means some things will be discarded. ..."[M]any universities may die or may change beyond recognition as a result of the IT [Information Technology] revolution. When asked what his light bulb would mean for the candle industry, Thomas Edison reportedly replied, 'We will make electricity so cheap that only the rich will burn candles.' We are entering an era in which most colleges and universities must decide whether to change a little (and thus remain in the academic candle industry) or a lot (and launch themselves into the academic electrical business)." Langenberg, (1996). If the cost trends of instructional technology and textbooks continue, will in not be only be a matter of time before only the rich can afford books?

Break free from conventional bonds, thinking

The term horseless carriage was used to define the first automobiles-a blend of the old and new. But retaining the old, while providing some level of comfort, may have hindered the appearance of the new. Perhaps the term distance education will conjur up images of the classroom in different regions and have a stiffling effect on the culture change necessary.

One way to break from conventional bonds is the look at things from a different perspective. It has been said that a chicken can be defined as a device which an egg uses to reproduce itself. Society began to be linked by three infrastructures: transportation, energy systems and communication. Transportation and communication were at first limited to following waterways and roads, then expanded to space through airplanes. Communication then expanded through every nook and cranny of space with the telegraph, telephone and fax. It also expanded through time, ranging from days to deliver mail to seconds to send and receive e-mail. Consider this example. When US President Lincoln was shot, it took 2 weeks for the news to reach the office of the Times in London. When President Ronald Reagan was shot, a Times reporter working a few blocks from the shooting learned of the event in about two minutes--from a message relayed back from the London office.

It is now possible for an instructor and students to function from any location in the world where the Internet can be accessed; we are transcending the restrictions of time and location. Before we can take advantage and make widespread application, several issues must be addressed, the easiest of which is probably the mechanical technology, at least in most parts of the developed world. A sample of other issues includes: reluctance on the part of administrators to supervise instructors who are not (always) physically present and

a strong belief or mental model of the efficacy of face-to-face instruction. For more on how mental models can inhibit the use of instructional technology to enhance the field of learning, see Szabo (1998).

One scenario goes like this. First, all the academic services of educational institutions would be rebundled and offered in a combination of centrality and local autonomy. A student could apply, register, take courses, receive credits and certification and participate in the life of any academic institutions from one central institution or clearinghouse. A small scale version of this arrangement can be found in the National Technological University in Colorado.

Second, all programs, courses, and course components (modules and objectives) would be modularized and arranged into sequences to accommodate different preparations and individuals. At the sub-course level (modules), each module would be either required or optional, depending upon 1) the program of study, 2) prior knowledge of the individual student as assessed by computer-managed instruction, electronic portfolio, or observed performance (using videoconference), or 3) completion of prerequisites. All of this information, down to the minutest of detail, including every assignment, score, date of completion, number of repeats, etc. will be tracked and managed in the database. It will be available through the search engine for information and decision-making by students, instructors and administrators alike. A large scale version of such a system was created and operated successfully for decades as the PLATO system, developed and the University of Illinois, transformed into a commercial venture by Control Data Corporation and later expanded to provide two-way interactive computer-based instruction by satellite and telephone.

To carry the illustration out a bit more, once a student has settled on a unique combination of courses and modules to be mastered, a choice of instructional methodology can be made. For each module in the course, a student could choose to participate in a lecture, either in person or via whatever replaces what we currently call streamed video. Alternatively the student could choose a seminar format with students from across the globe. Other choices would be available, such as computer based instruction and selection of a specific level of interaction with peers and experts. Or, the student could choose to learn in a problem-based immersive learning environment, the kind which Tiffin and Rajasingham (1995, pp. 13-15) have described.

> Shirley zips into her skin-tight school uniform which on the outside looks something like a ski suit. The lining of the suit is fact contains cabling that makes the suit a communication system and there are pressure pads where the suit touches skin that give a sense of touch. Next, she sits astride something that is a bit like a motorbike except that it has no wheels and is attached firmly to the floor. Her feet fit on to something similar to a brake and accelerator and her gloved hands hold on to handlebar. She shouts, "I'm off to school dad." Her father, who is taking time out from his teleworking, begins to remind her that the family are going teleshopping in the virtual city later in the day, but it its too late, his daughter has already donned her school helmet. She is no longer in the real world of her real home, she is tin the virtual world of her virtual school.
>
> The moment the helmet closes over her head, Shirley finds herself looking at an information map of her school and her own academic activities. There is her individual school diary of daily activities and appointments, class timetable and academic calendar. She can for any particular class see what will happen, at what time, for how long, or when a particular assignment is due. Her overall progress in terms of her chosen career path is charted. Of course she can reschedule. This involves a session with a computer-assisted counseling (CAC) which just might refer the case to a human counselor especially if a change of classes is involved. Much of her instruction is asynchronous and

computer based and presents no practical problems to creating an individual timetable. The CAC concern is with how changes affect her long-term career goals.

As she turns her head there are notices about the society meetings and extra-curricular activities she is involved with. If she asked about any of the thousands of events and activities going on in her areas of interest, notices about them would be brought to her attention. A couple of notices have signs winking on and off to show someone wants to get in touch with her. Before responding to them, however, she looks up to check the time (the clock is always there whenever she looks up) and notices that she has fifteen minutes before her class in geo studies begins. She looks at the info map of school functions. Library, registration, counseling, health services, research laboratory, computer room and classroom are all clearly marked. To go to any one of them all she has to do is to reach forward and 'touch' them and she will be there. She could go straight to the virtual class. Maybe some other students are already there. The-pre-class chats are fun with people from so many cultures. She often wonders how many students there really are in the virtual school and how many countries that represents. Today, however, she is leading her group's presentation on glacial retreat as evidence of global warming and she is not sure of her grasp of the concept involved. Putting timetable on automatic, which means that when a class begins she will automatically find herself in the class, she selects the terraforming and flight overview options. As the simulation forms around her she gets the familiar feeling of butterflies in the stomach as she finds herself hovering a thousand feet about the Franz Josef glacier. She reaches for the reassuring touch of the handlebars and, kicking the accelerator with her right foot, leans forward on the handlebars and zooms down to the front of the glacier. As she reaches the position she wants, she decelerates with the left foot until she is hovering just in front of the glacier. She touches the function key that gives her the 'simulations capability index' and selects 'glacier movement' at a century per second starting at 2000 BC. The term 'glacier' to her means something that moves so slowly it hardly seems to move at all, so she is startled by the size and speed of the glacier's advances and retreats at this rate and quickly slows the simulation down to study it more carefully. Suddenly the glacier disappears and is replaced by three-dimensional images of her teachers and classmates sitting in a sun-

> dappled glad while deer graze among them in the Arcadian forest they have designed for their virtual learning space. The virtual class is starting.

There are myriad details of how this could or should take shape; too many to include here. An extensive review of immersive instruction through virtual reality technology may be found in McLellan (1996). The outcome, however, is that any student can access the best education in the world from any location in the world in any time zone. The global brain will be strengthened. Now if we could just make similar progress and expand results like these into the arena of ethics, morals, and the realm of spirituality.

Change is guaranteed but what that future will look like must wait until it happens. It is likely however that change will continue at a rapid, even accelarating pace. Several other conjectures come to mind. First, unlike most of the rest of our economic, social and cultural environment, education has to date been largely untouched by the sweeping changes arising from the ICT revolution. It seems likely that this will change; that ICT will ultimately have a transforming effect upon the way we conceive of and deliver educational services.

Focus on Assessment

Focus on moral and ethical guidance

Examine the validity of articles and individuals or groups who provide counsel which cautions us about the dangers of moving directly into the ICT revolution. For example, Cooper (1999) identifies some significant and some humorous mis-applications of technology which have implications for the design of ICT systems. Postman (1992, 1995) documents vast changes which have been brought about by technology throughout the history of humankind and asks us to be cognizant of what we have given and will give up in order to embrace technology in general. Nasbitt, Naisbitt and Philips (1999)

conclude that examination of the machine technologies of computers, the Internet, telecommunications and genetic technologies reveals the emerging power we have over our destinies and the need for a moral compass to guide us. Others (e.g., Noble, 1997; Feenberg, 1999) ask questions as to the role (if any) of IT in teaching and learning.

Glossary

Cyberspace: "information space that exists within computer processing units and data storage devices across all computers and telecommunications networks" Ruzic, 1999, p. 18) "past, present and future".

Telepresence: The illusion that one is present in another environment.

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Impact of New Information and Communication Technologies (ICTs) on Socioeconomic and Educational Development of Africa and the Asia-Pacific:

A Pilot Study

Levi Obijiofor and Sohail Inayatullah with Tony Stevenson

Executive Summary

This preliminary research on ICT adoption in Africa and the Asia-Pacific suggests that there are serious barriers to their use in educational and socioeconomic development, such as issues of infrastructure support, access to the ICTs, training and skills development, and hierarchical social relations which determine who has access to ICT. Generally ICTs are considered appropriate, even though there remain concerns over economic priorities, basic needs or computers.

However, the implementation of ICTs is occurring in a context where the cultural and institutional barriers are not well addressed. The assumption often made is that if one just purchases a few computers and modems, a post-industrial society can magically result. Africans and those in the Asia-Pacific are generally in the position of consumers and thus in a position where they cannot yet define the media in their terms.

At the same time, conservative attitudes entrenched in Asia-Pacific countries and concern over basic needs inhibit appreciation of the importance of new ICTs. For example, in Fiji and the Philippines, people believe ICTs are not the most important needs in their societies and that people can always find a way to get along if ICT use becomes a matter of "life and death".

Basic education, equipping schools with enough texts and reducing the

teacher-student ratio, and seeing culturally relevant programs on television seem to be the major concerns of most of the respondents. There is also fear that the Internet could corrupt the morals of their society through easy access to pornography and other culturally "reprehensible" material. The use of ICTs for interactive education, for pedagogy that leads to communication and information richness is not yet adequately understood or developed.

The College Classroom of the Year 2010

Seminar for Presidents of Community and Junior Colleges

from Japan and the United States

East-West Center

June 8, 1993

Jim Dator

Professor, Department of Political Science,

Director, Hawaii Research Center for Futures Studies,

University of Hawaii, and

President, World Futures Studies Federation

About ten years ago, a famous scholar of American education, John Goodlad, surveyed a wide sampling of American schools in every part of the United States, and in every kind of community--rich, poor, or middle class. He looked at the mission statements which boards of education promulgated. He read curriculum guides which departments of education mandated. He analyzed course curricula which individual teachers prepared. He, and his staff, visited thousands of classrooms and watched teachers actually teach. He observed what students actually did in school each day. He noted the physical conditions of the classroom, of the school building, and of the campus. He talked with teachers, students, and parents. And he came to one overwhelming conclusion.

In spite of periodic public outcry about the sorry condition of American education, and countless commissions over the years which issued countless calls for curriculum change and innovation--and in spite the attempt by countless teachers to offer innovative courses--the classroom of the present, what is taught in the classroom, and how it is taught, has not changed significantly for over one hundred years.

And

"The role of teacher will change: from repository of expertise to guide to resources. Rather than playing the role of expert or know-it-all, the teacher will be a mediator between the student and resources that far exceed what any individual, even the most skilled or brilliant scholar, could know. Librarians are better models for this role than are research scientists." (p. 15).

My classes now, with each student on email and computer conferencing, are already almost completely out
of my control. The students are teaching themselves and each other, and certainly they are teaching me. Moreover, they are doing so morning, noon, and night,
every day of the week. The only reason they come to the classroom at all on the assigned times is because the University expects this of them--and, more
importantly, the University expects it of me.

Questions about the lack of human touch (always raised by people who first hear of this scenario) are totally beside the point. Try using email and computer
conferencing for a while--you will be more humanly in touch with more people than you ever have before! Surely it is more humane than the average mass
classroom lecture experience--and definitely more humane than this boring lecture you are enduring from me today!!

n "Education Inc.," all education (except maybe for the poorest, dumbest and most incorrigible persons), is taken over by big businesses.

In the US, there is already McDonald's University, Motorola University, and IBM University. In Japan, which does not hesitate to link private with public purpose, many of you already are heading colleges whose curriculum is basically determined by the labor, technical and marketing needs of one or a few corporations. For you, in this respect, the future is now, and you are merely once again harbingers of more sweeping changes yet to come for everyone everywhere.

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The "Education Inc." scenario is also driven by the recent manifest triumph of economics over politics, as seen most clearly in the collapse of Communism. In addition, in the US especially, there is an incessant demand from all businesses for "better prepared" students. This scenario also seems quite likely given the great amount of training and retraining businesses already do simply because colleges and universities can't keep up with the dramatically and perpetually changing needs of businesses.

In the premier edition of a new magazine, WIRED, a futurist for many years associated with the Hudson Institute wrote:

"Education is the last great bastion of socialist economics. Public education is a redundant term: more than 90% of the services provided by educational institutions in the US are owned, operated, subsidized and/or regulated by government. Schools and colleges are as productive and innovative as were Soviet collective farms." (p. 71)

Elsewhere, Perelman says, "As the growing unemployment of our most schooled workers demonstrates, academic success is at best irrelevant and may even be harmful to working productively in the real world." "Think about it," he says. "In what other domain of work or social life is a premium placed on your ability to sit in rows of desks in a room, be talked at for fifty minutes, and then, when a bell rings, to walk down a hall to another room to repeat the same experience again and again during the day?" (p. 72)

What we need instead, says Perelman, is "hyperlearning" which can be achieved if we "form a coalition that demands the commercial privatization of the entire education sector." (104) "School's Out," he says. Let's sweep it into the rubbish can of history.

SCENARIO THREE which the GBN calls "The New Educational Order."

This is GBN's version of the preferred future I have been flogging for many years as well. The election of Clinton, and especially of Gore, helped feed my enthusiasm for it as a slight possibility, although recent political realities in the US, and Japan, have almost extinguished my flickering flame of optimism. Nonetheless, there is some mild reason to hope that the era of the glorification of individual greed is over (at least for a while), and that an era of growing social responsibility is emerging.

But beyond that, the growing awareness of the seriousness of environmental sustainability--and the fact that this was caused by foolish economic/industrial practices of the past and present--coupled with the recognition that regardless of who caused what or benefited from what in the past, we will all be stewing in the same Greenhouse juices in the future--this awareness is dawning in more and more consciousnesses everywhere.

Available at http://www.soc.hawaii.edu/future/dator/education/class2010.html

"The National Information Infrastructure (NII) is a vehicle for virtual communities, a conduit for knowledge utilities, and a synthetic environment with new frontiers to explore and experience. During the next decade, these emerging capabilities will leverage more change in education than has occurred over the past two centuries.

"Ubiquitous access to sophisticated information undermines the campus-based, classroom-centered structure of academic learning environments. Virtual communities can complement face-to-face relationships among students and faculty. In higher education, presented with the alternative of technology-mediated interaction such as telephone registration or video-based classes, an ever increasing number of part-time students appreciate the convenience despite the loss of opportunities for spontaneous, face-to-face socializing.

"In the NII, broad-band networking coupled with collaborative tools, will empower "telepresence," shared social environments without physical proximity. As education incorporates opportunities for telepresence in remote access to libraries, computer labs, on-line advising, and video-based classes, the convenience of just-in-time, anyplace service will shift academic interactions increasingly--but not completely--into virtual communities and classrooms with electronic walls.

"Through such teleapprenticeship approaches, a widely distributed group of students can engage in simulated, real-time experiences (e.g. virtual hospitals, factories). Their ability to apply abstract knowledge is enhanced by situating education in mentored, virtual contexts similar to the environments in which skills will be used. Moreover, knowledge taught just-in-time to resolve a problem is mastered more readily than when taught just-in-case as part of covering material.

Interdisciplinary, learning-by-doing experiences in artificial environments made possible by the NII will likely supplement discipline-centered, campus-based teaching-by-telling.

At present, most faculty and administrators are coping with its first impact: shifting from foraging for data to filtering a plethora of incoming information.

Educational leaders in the next decade must develop a comprehension of how to use this new medium to empower new messages and mission, and how to collaborate with and/or outperform competitors."

[Christopher Dede, "Beyond the Information Superhighway," Linkages, 2.2 (Spring/Summer), 1994]

More iconoclastically, Eli Noam, director of Columbia's University's Institute for Tel-Information, wrote an article on the future of the university which was published last year in Science magazine, certainly the most widely read and respected journal of the American scientific community. Prof. Noam also made it clear that, in his words, "many of the physical mega universities of the present are not sustainable, certainly not in their present duplicative variations. " Noam expects that "ten years from now a significant share of conventional mass education will be offered commercially and electronically." ["Eli Noam on the Future of the University," Educom Review, July/August 1996, p. 38]

Subsequently, an editorial appeared in Science written by Donald Langenberg, former deputy director of the National Science Foundation, former Chancellor of the University of Illinois, and presently the Chancellor of the gigantic University of Maryland System. Chancellor Langenberg states that

> ...[M]any universities may die or may change beyond recognition as a result of the IT [Information Technology] revolution. When asked what his light bulb would mean for the candle industry, Thomas Edison reportedly replied, 'We will make electricity so cheap that only the rich will burn candles.' We are entering an era in which most colleges and universities must decide whether to change a little (and thus remain in the academic candle industry) or a lot (and launch themselves into the academic electrical business). Barring a catastrophic reduction in the nation's commitment to research, the 100 or so major research universities probably will persist in recognizable form. Several hundred institutions whose primary focus is liberal education of full-time, campus-resident, recent high-school graduates will persist as well. That leaves about 3000 institutions of higher education serving the vast majority of the nation's 14,400,000 college and university students in ways that will inevitably be profoundly transformed by IT.
>
> "....Resistance to radical change will probably be substantial within academe, many of whose members will argue that IT is a threat to the essential traditional values of real education and that its pervasive use can result only in pervasive mediocrity. I anticipate that much of higher education's clientele will decide

otherwise. I expect that we will see academic examples of the phenomenon reported by a bank official who, when visiting a branch office, observed several unoccupied human tellers idly watching the progress of a long line of customers at the ATM."

[Donald Langenberg, "Power Plants or Candle Factories." Science June 21, 1996]

"1. Is your organization primarily in the information business? (If yes, go to 2.)

"2. Does your organization "communicate" existing information to its customers without really adding value? (If yes, go to 3.)

"3. Does your organization require a physical location in order to "communicate" the information to its customers? (If yes, a theme park is in your future!)

["Will Colleges and Banks Turn Into Theme Parks?" 2020 World Digest, Monday 7 November, 1994, Vol. 01, Number 028]

Good-bye Academic Freedom?

But the biggest challenge which the future brings to what I think is the most valuable aspect of higher education in America is one which has always been fragile and threatened, but has, until now, been comparatively easy to hide and protect--namely "academic freedom."

In "Intellectual Freedom in the Virtual University," William Morey, Bart Binning, Paul Combs observe that

"The walls of the academy that previously sheltered the concepts of intellectual freedom are becoming electronic tentacles that extend into the home and the global workplace. The free exchange of ideas and artistic expressions that have traditionally been acceptable inside the classroom may not be so acceptable when other stakeholders in education can view only portions of the educational process. The messages that are part of the give and take of the college classroom processes of synthesis and evaluation may seem different when being delivered over the information highway. The Internet allows educational stakeholders to glimpse classroom 'sound-bites' that may take on entirely different meanings when viewed outside the context of intellectual give and take."

"The idea of the virtual classroom and its virtual university makes the distinction between inside and outside the university community more difficult to maintain. Electronic multimedia-on-demand are making the protective walls of the university community very permeable. The World Wide Web, with its spreading interconnected links to a world-wide array of documents expressing a plethora of ideas, now allows students to both explore those ideas and to freely express their thoughts to a world-wide audience."

"Liability and copyright laws are of particular concern. How many times has a student made rash and irresponsible statements in a classroom environment that

would lead to potential legal liability were the same statements seen in a public television broadcast?"

[William Morey, Bart Binning, Paul Combs, "Intellectual Freedom in the Virtual University," Bart Binning <binning@aix1.ucok.edu>, presented at the Southwest Business Symposium, April 11, 1996, Oklahoma City, Oklahoma]

Well, I was going to add some things about the substantive focus of education in and for the future, but I will conclude only by stating, and not attempting to substantiate, the following three points:

First, Western culture will not be the dominant culture of the 21st Century and beyond. Instead, Western culture will be Number Four behind Confucian, Hindic, and Islamic cultures, and, in Hawaii, behind the revitalized Hawaii cultures. And all cultures will themselves be transformed and changed by the forces I have been discussing, and many I have not. So the future of Confucian--or Hawaiian--or Western--culture, and all the rest is not likely to be a linear extension of the past or present. Curricula of and for the future should recognize this more manifestly, and celebrate it.

Second, while established academic disciplines, departments, and schools will have a role in the future, they will not, and they cannot, continue to play the rock bottom central core role they play at present. That role was OK in the good old days when many believed that "nature" and "truth" lay "out there" somewhere to be discovered. Even if that was a reasonable assumption "then" it is not tenable "now", much less for tomorrow.

The reason is this. For good or ill, humans have acted in their past so as to have essentially destroyed "nature". It is now humanity's challenge to invent, create, and sustain life, if we wish life, especially humanity, to persist into the future. And so it is the urgent, and largely unfulfilled, task of all education to help us learn how to "govern evolution." That is a task which probably exceeds the capabilities, not only of any educational system conceivable, but of humanity per se.

But that, nonetheless, is where we are at present, and the challenge which lies ahead, ready or not.

And so, thirdly, it goes without saying that we do not have a sustainable environment for the future. But neither do we have a sustainable economic system or political system. We clearly must do the very creative and hard work of envisioning, inventing, building, and sustaining a new political-economy as well as a new environment during the 21st century if we think humans should exist in the 22nd.

And, of course, I can't think of any good reason why humans should continue to exist, but maybe you can come up with some.

The Futures of Universities: Ivied Halls, Virtual Malls, or Theme Parks? FUTURES, Vol. 30, No 7, September 1998, pp. 615-623

Fred Rossini has said that the university of the future will be a network and not a place. Clearly, the old agricultural extension agents, the current colleges of continuing education and of distance education, the "open universities of the air" and the "global electronic universities" knit together by satellites and cable are the waves of the future…The old centralized college campus, where information resides in the print of books and journals, and, somewhat more hazily, in the minds of professors, such that for the information to get to the students, the students had to come to the professors and the libraries--these will soon be gone foreover. The one-two punch of economics and technologies is killing them.

Global villages, local villages and the future of tertiary education

For the international conference,
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Jim Dator

High Tech, High Touch: Technology and Our Search for Meaning, John Naisbitt with Nana Naisbitt
and Douglas Philips, Broadway Books, New York, 1999

With American culture now increasingly broadcast through technology - from TV and movies to music to the Internet and electronic games -
we are living in what John Naisbitt calls the Technologically Intoxicated Zone. This zone is a confusing and distracted state where we both
fear and worship technology, where we see technologies as toys and quick-fixes, and where we become obsessed with what is "real" and
what is "fake" - from the violent games children play to genetically-engineered animals to whether one can claim to have scaled Everest if
supplemental oxygen was used.

It is technology's saturation of American society - with its fabulous innovations and its devastating consequences that Naisbitt and his
co-authors explore in this timely book. By consciously examining our relationship with technology as consumer of products, media and
emerging genetic technologies, that we can learn to become aware of the impact technology will have on our daily lives, our children, our
religiosity, our arts and our humanness. High Tech, High Touch is a cautionary tale that shows us how to make the most of technology's
benefits while minimizing its detrimental effects on our culture.In a compelling tour of our technological immersion as we work and play and
search for spiritual path, Naisbitt tackles complex questions. Does technology free us from constraints of the physical world, or does it tie us

down to our machines? Does it save time in our day-to-day lives, or does it merely create a void we feel compelled to fill with even more tasks and responsibilities. What about advances in biotechnology? Recent developments in genetic engineering now raise the possibility of a future that will some day be free of the birth defects, disabilities, and diseases that mark our lives today. But in an age where such things are possible, what is natural and what is artificial? And when people can be created in the laboratory as easily as the womb, what then, does it truly mean to be human?

Moving from the information and machine technologies of computers, the Internet, and telecommunications to the genetic technologies that are transforming biological science and art, the book reveals the emerging power we have over our destinies - and the need for a moral compass to guide us. Whether you work inside or outside education, whether your focus is on schools or business, this is an ideal book to usher in a century in which these issues will become even more timely.

For more on the man who developed the mouse, check out the stanford review of englebart's work. http://unrev.stanford.edu/

Paul Saffo on the future, available at http://palm.fgreen.com/infoworld/interviews/saffo.html#GETTING OUT OF THE BOX

Welcome to the InfoWorld Futures Project interviews -- a series of in-depth discussions with members of the InfoWorld Futures Board, a distinguished group of leaders in technology, communications, science, publishing, advertising, and more.

"never mistake a clear view for a short distance. Just because something seems terribly obvious and terribly necessary does not mean it's going to happen quickly. Think of all the things we're still waiting for that seemed so obvious in 1980."

"it's our response to the technologies that drive change. In other words, first we invent our technologies and then we use our technologies to reinvent ourselves...our families, our societies, and our entire cultures."

"Conventional wisdom is almost always wrong."

"TV delivered the world to our living rooms but all we could do was press our nose against the glass and watch. The computer allows us to not only see the world delivered before us, but to reach out and touch the rest of the world beyond."

"One thing is for sure: people who fret about computers being central in our lives today...they ain't seen nothing yet. Worrying about how central computers are in our lives today, compared to what they will be 10-20 years from now, is going to look as

ridiculous as someone in 1965 saying how utterly dependent they were on computers because mainframes with punchcards were doing payrolls."

"The Web is at once a medium and an organizing medium. It has intrinsic in its environment the link-making capabilities to organize information and it has information itself. So it's a flip of the coin what's more important on the Web ... the information or the structure it imposes on information."

"history really informs one to be a short-term pessimist and a long-term optimist. No matter how screwed up things get in the short run they tend to self-correct and we end up better in the long run."

Mark Twain could have been speaking for all of us when he said, "You know, I'm all for progress, it's change I object to."

"we are all preoccupied with trying to get standards established, and that's a good thing. But few people realize that once standards are established they stay around for vastly longer than we would wish and are used for purposes we never intended. And that's where vertigo comes in because if people realized the consequence of the standards karma they would be completely immobilized."

Human computer interface issues

http://cooper.com/books/t_chapter1.html

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